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Description

THREAD ROLLING TOOL

BACKGROUND OF INVENTION

[0001] 1.FIELD OF THE INVENTION.

[0002] The present invention is generally related to the field of thread formation, and, more particularly, to a thread rolling tool that may be employed in forming threads on various components.

[0003] 2.DESCRIPTION OF THE RELATED ART.

[0004] Threaded connections are very commonplace for connecting various components to one another. For example, in the oilfield industry, sections of pipe or tubulars are sometimes connected to one another by a threaded connection, i.e., a box (female) threaded connection formed on one end of a pipe, and a pin (male) threaded connection formed on the other end of the pipe. Sections of pipe are coupled to one another by these threaded connections. Of course, there are many other industries and applications where threaded connections are routinely and

widely employed.

[0005] There are a variety of well known manufacturing techniques for forming threads on the various components. Moreover, the size, shape and configuration of the threads formed by such processes may vary widely depending upon the particular application and the anticipated loading conditions. In some cases, threads are formed by a process wherein a cutting tool is employed to form the threads in the component, e.g., a section of pipe, using a lathe and known tooling components. Thereafter, in some cases, it is desirable that the mechanical properties of the threads be enhanced by cold working the threads, i.e., it is desirable to enhance the mechanism properties of the root of the threads and the various thread surfaces where high stress points could result in fatigue failure. By cold working the threads, various mechanical properties of the thread may be improved, e.g., hardness, etc. There are many tools and techniques on the market for cold working threads. Most of such thread rolling tools are designed to fit onto CNC machines and/or are designed for use with industry standard thread profiles, e.g., API connectors.

[0006] Figure 1 provides a schematic example of at least one

technique for cold working threads formed on a component. As depicted therein, a plurality of schematically depicted threads 10 are formed on a component 12. A cold roll wheel 14 having an end 16 is depicted positioned above the threads 10. After the threads 10 are initially formed by, for example, a cutting process, the cold roll wheel 14 may be used to cold work the threads 10. Ideally, the end 16 of the wheel 14 will be positioned in the threads 10 such that the end 16 is aligned with the root 18 of a particular thread. Thereafter, force is applied to the cold roll wheel 14 (by, for example, actuating one or more levers on the lathe) and the wheel 14 follows the path of the threads 10 thereby cold working the threads 10 to improve the mechanical properties thereof.

[0007] However, in practice, it is very difficult to precisely locate the end 16 of the cold roll wheel 14 at the desired location on the thread profile. More specifically, in most thread rolling tools, the relative position of the end 16 of the cold roll wheel 14 relative to a holder (not shown) that is used to secure the cold roll tool to a machine tool is fixed. Thus, in using the existing thread rolling tools, a machinist must expend great time and effort trying to insure that the end 16 of the wheel 14 is properly posi-

tioned in the root 18 of the thread 10. Such efforts may include the use of mirrors and additional lighting in an effort to insure that the end 16 is properly located in the root 18. Properly locating the end 16 in the root 18 of the thread is critical to the cold working operation. Absent proper alignment, the cold working process, where pressure on the order of, for example, approximately 1000 psi or so is applied to the thread 10 via the wheel 14, may damage or destroy the previously formed thread profiles. For example, a wheel 14 (in dashed lines) that is misaligned with respect to the root 18 is depicted in Figure 1. If the end 16 of the misaligned wheel 14 is located at a position relatively far from the root 18 of the thread, application of pressure to the wheel 14 to cold work the threads may damage the existing thread profile. At a minimum, the cold working process may not result in the desired finished product if the end 16 of the wheel 14 is not properly positioned in the threads 10. Moreover, the positioning of prior art thread rolling tools is very time consuming, thereby limiting productivity. Lastly, due to the difficult in properly aligning the prior art thread rolling tool described above, the chance of producing defective end products is increased.

[0008] The present invention is directed to an apparatus and methods for solving, or at least reducing the effects of, some or all of the aforementioned problems.

SUMMARY OF INVENTION

[0009] The present invention is directed to a thread rolling tool that may be used in forming various threads. In one illustrative embodiment, the tool comprises a tool holder, a boring bar and a cold roll wheel operatively coupled to the boring bar, wherein a position of the cold roll wheel relative to the tool holder along a first direction is moveable.

[0010] In another illustrative embodiment, the tool comprises a tool holder, a boring bar slidingly coupled to the tool holder to thereby allow movement of the boring bar in a first direction relative to the tool holder, and a cold roll wheel operatively coupled to the boring bar.

[0011] In yet another illustrative embodiment, the tool comprises a tool holder, a boring bar that extends through and is slidingly coupled to the tool holder to thereby allow movement of the boring bar in a first direction relative to the tool holder, a cold roll wheel operatively coupled to the boring bar and at least one projection for limiting travel of the boring bar relative to the tool holder along the first direction.

BRIEF DESCRIPTION OF DRAWINGS

[0012] The invention may be understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements.

[0013] Figure 1 is a schematic depiction of an illustrative thread profile in a cold forming tool in accordance with prior art techniques.

[0014] Figure 2 is a schematic depiction of an illustrative lathe having a thread rolling tool in accordance with one aspect of the present invention positioned therein.

[0015] Figures 3A-3C are various views of an illustrative thread rolling tool in accordance with one embodiment of the present invention.

[0016] Figures 4A and 4B are views of one illustrative embodiment of the thread rolling tool during the assembly process.

[0017] Figures 5A and 5B are illustrative views of a thread rolling tool in accordance with the present invention positioned in a lathe.

[0018] While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and are

herein described in detail. It should be understood, however, that the description herein of specific embodiments is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

[0019] Illustrative embodiments of the invention are described below. In the interest of clarity, not all features of an actual implementation are described in this specification. It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developers" specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

[0020] The present invention will now be described with reference to the attached figures. The words and phrases used

herein should be understood and interpreted to have a meaning consistent with the understanding of those words and phrases by those skilled in the relevant art. No special definition of a term or phrase, i.e., a definition that is different from the ordinary and customary meaning as understood by those skilled in the art, is intended to be implied by consistent usage of the term or phrase herein. To the extent that a term or phrase is intended to have a special meaning, i.e., a meaning other than that understood by skilled artisans, such a special definition will be expressly set forth in the specification in a definitional manner that directly and unequivocally provides the special definition for the term or phrase.

[0021] In general, the present invention is directed to a thread rolling tool that may be used in cold working threads. As will be recognized by those skilled in the art after a complete reading of the present application, the present invention may be employed with the formation of a variety of different types of threads on a variety of different type components. Thus, the present invention should not be considered as limited to the formation of any particular type of thread on any particular type of component unless such limitations are expressly set forth in the appended

claims.

[0022] Figure 2 is a schematic depiction of an illustrative lathe 20 having a thread rolling tool 22 in accordance with one embodiment of the present invention positioned therein. The lathe 20 is provided by way of example only and it should be understood to be representative of any of a variety of different types of lathes or other machinery used to initially form a thread prior to performing a cold working process on the thread, or a machine that is involved in any process of cold working threads. Thus, the present invention should not be considered as limited in any respect as to the equipment or methodologies used in forming the thread unless such limitations are expressly set forth in the appended claims. As shown therein, the lathe 20 is comprised of a head stock 24, a chuck 26, a tool post 30, a bed 32, a cross slide lever 34, a longitudinal slide control 36 and a gear engagement lever 38. Also depicted in Figure 2 is an illustrative workpiece 28, e.g., a section of pipe. The thread rolling tool 22 is secured to the tool post 30 by a plurality of threaded pins 31.

[0023] Figures 3A and 3C are top and side views, respectively, of one illustrative embodiment of the thread rolling tool 22 disclosed herein. Figure 3B is an enlarged view of a por-

tion of the thread rolling tool 22. As shown in these drawings, the thread rolling tool 22 is comprised of a moveable boring bar 42 that is slidingly coupled to a tool holder 40. That is, there is a sliding clearance between the tool holder 40 and the moveable boring bar 42 to allow the bar 42 to slide within the tool holder 40 in a first direction, as indicated by the double arrow 60, i.e., in a direction that is approximately parallel to the longitudinal axis of the boring bar 42. In the depicted embodiment, the tool holder 40 is comprised of a generally cylindrical body 41 and a clamp block 46 that is of a generally rectangular shape. A key 44 is used to limit relative movement between the moveable boring bar 42 and the tool holder 40 in a second direction, i.e., to limit rotational movement between the moveable boring bar 42 and the tool holder 40 around the longitudinal axis of the boring bar 42. Also, projections 48, i.e., screws, are provided to limit relative longitudinal movement of the moveable boring bar 42 relative to the tool holder 40 in the first direction. In one illustrative embodiment, the screws 48 are located in position so as to limit the relative travel between the moveable boring bar 42 and the tool holder 40 along the first direction 60 to approximately 1-2 inches. Of

course, the limit of this travel may be adjusted depending upon a particular application. In the depicted embodiment, the clamp block 46 has a generally rectangular configuration to facilitate securement of the thread rolling tool 22 to the tool post 30 on the lathe 20 via the threaded pins 31. Of course, as will be recognized by those skilled in the art, this particular configuration may be varied depending upon, for example, the configuration of the machine that employs the thread rolling tool 22 of the present inventions. That is, other mechanisms may be provided to insure that the thread rolling tool 22 may be secured to a machine, e.g., lathe 20, that may be employed in using the present invention.

[0024] The thread rolling tool 22 further comprises a cold roll wheel 50 having an end 51, a piston 52, a dowel pin 54 that connects the wheel 50 to the piston 52, a piston limit pin 56 that is used to limit the vertical movement of the piston 52 and an O-ring 58 that provides the necessary seal for hydraulic fluid employed in the present invention. The moveable boring bar 42 has an internal passageway 62 formed therein and a pressure gauge 63 is coupled to the moveable boring bar 42. The hydraulic fluid within the internal passageway 62 transmits the pressure acting on

the wheel 50 to the pressure gauge 63. This pressure may be observed by a machinist.

[0025] Figures 4A and 4B are various views depicting the assembly sequence of the thread rolling tool 22 in accordance with one embodiment of the present invention. As shown in Figure 4A, a slot 66 is formed in the moveable boring bar 42 and a key 44 is positioned therein. The size and configuration of the key 44 and slot 66 may vary depending upon the desired application. In one illustrative embodiment, the key 44 may be approximately four inches in length (along the axial direction of the moveable boring bar 42) and its surface 44A may protrude above a surface 42A of the moveable boring bar 42 by a distance of approximately one-half inch. A slot 68 is formed in the tool holder 40 and is adapted to receive the key 44 positioned therein. The use of the key 44 limits relative movement of the moveable boring bar 42 and the tool holder 40 in a given direction, i.e., the key 44 limits relative rotational movement between the tool holder 40 and the moveable boring bar 42. As indicated in Figure 4B, after the tool holder 40 is properly positioned over the key 44, protrusions, i.e., screws 48, may be secured in place at the desired location to thereby limit the relative travel between

the moveable boring bar 42 and the tool holder 40 in a first direction, e.g., in a longitudinal direction that is approximately parallel with a longitudinal axis of the moveable boring bar 42..

[0026] The operation and use of the thread rolling tool 22 of the present invention will now be described. At some point during the course of assembly of the thread rolling tool 22, hydraulic fluid will be introduced into the internal passageways 62 of the tool, via openings provided for the protrusions 48, e.g., screws, and/or the opening provided to allow fluid communication with the pressure gauge 63. Typically, the screws 48 will be used as a means to fill and bleed off air within the internal passageway 62 and/or the piston 52 of the thread rolling tool 22. Once the system is properly filled with hydraulic fluid, it may be positioned on the tool post 30 as indicated in Figures 5A and 5B. As shown therein, the thread rolling tool 22 is secured within the tool post 30 of the lathe 20 via a plurality of threaded pins 31. The threaded pins 31 engage the clamp block 46 on the tool holder 40. Of course, as indicated before, the particular mechanism and manner by which the tool holder 40 is secured to the lathe 20, or any other type of machinery, may vary depending upon the particular appli-

cation.

[0027] Once the thread rolling tool 22 of the present invention is properly positioned in the lathe 20, the machinist then advances the end 51 of the cold roll wheel 50 to a point where it is proximate a previously formed thread profile. By incremental actuation of various control levers on the lathe 20 and/or movement of the moveable boring bar 42, the end 51 of the cold roll wheel 50 may be brought into engagement with previously formed threads on the work-piece 28. Due to the fact that the thread rolling tool 22 of the present invention allows relative movement, e.g., in a longitudinal direction, between the cold roll wheel 50 and the tool holder 40, the end 51 of the wheel 50 can move (in a lateral direction) so that it may tend to naturally find the proper position within the thread profile, i.e., the end 51 may be positioned at the root of the thread prior to beginning cold working operations. Moreover, as the lathe is actuated to apply pressure to the end 51 of the wheel 50, the self-alignment forces tend to become greater, i.e., the end 51 would tend to be biased toward the root of a particular thread profile due to the various tapered sur-faces.

[0028] Through use of the present invention, the end 51 of the

cold roll wheel 50 may be more quickly and properly positioned at the desired location prior to beginning cold working operations. Due to the allowed relative longitudinal movement between the cold roll wheel 50 and the tool holder 40, the present invention enables a machinist to readily locate and position the end 51 of the cold roll wheel 50 at the desired location. In turn, this improves manufacturing inefficiencies and leads to reduced waste.

[0029] The present invention is directed to a thread rolling tool that may be used in forming various threads. In one illustrative embodiment, the tool comprises a tool holder, a boring bar and a cold roll wheel operatively coupled to the boring bar, wherein a position of the cold roll wheel relative to the tool holder along a first direction is moveable.

[0030] In another illustrative embodiment, the tool comprises a tool holder, a boring bar slidingly coupled to the tool holder to thereby allow movement of the boring bar in a first direction relative to the tool holder, and a cold roll wheel operatively coupled to the boring bar.

[0031] In yet another illustrative embodiment, the tool comprises a tool holder, a boring bar that extends through and is slidingly coupled to the tool holder to thereby allow movement of the boring bar in a first direction relative to

the tool holder, a cold roll wheel operatively coupled to the boring bar and at least one projection for limiting travel of the boring bar relative to the tool holder along the first direction.

[0032] The particular embodiments disclosed above are illustrative only, as the invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. For example, the process steps set forth above may be performed in a different order. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the invention. Accordingly, the protection sought herein is as set forth in the claims below.